

# Large Radiofrequency Heat Lesions

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## Automatic Calibrated Ex Vivo Lesion Size Measurement

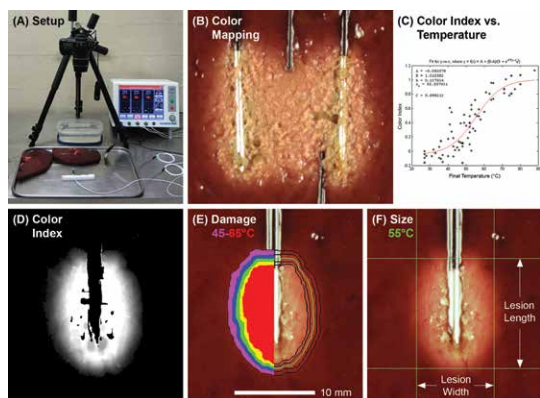


Figure 1 Multiple lesions averaged per configuration.

## Rounded Brick-Shaped Bipolar Lesions at Large Tip Spacings

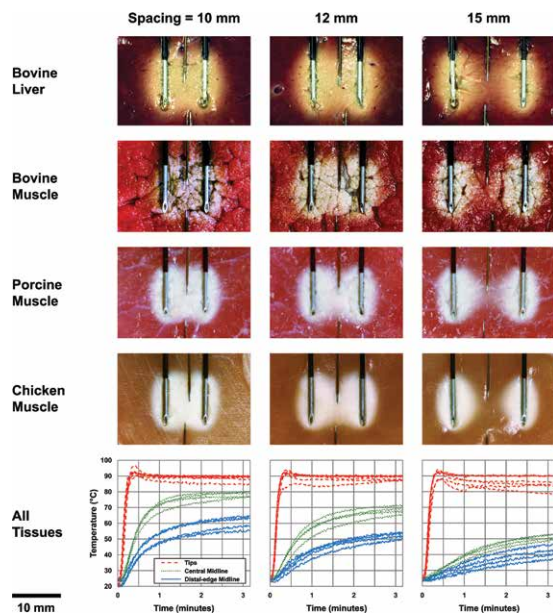


Figure 3 Muscle produces a similar thermal RF profile, but bovine liver color indicates lower neurolytic temperatures (45-50°C) and full lesion size.<sup>1</sup>

## Lesion Size Increases with Tip Length, Gauge, Temperature, and Time

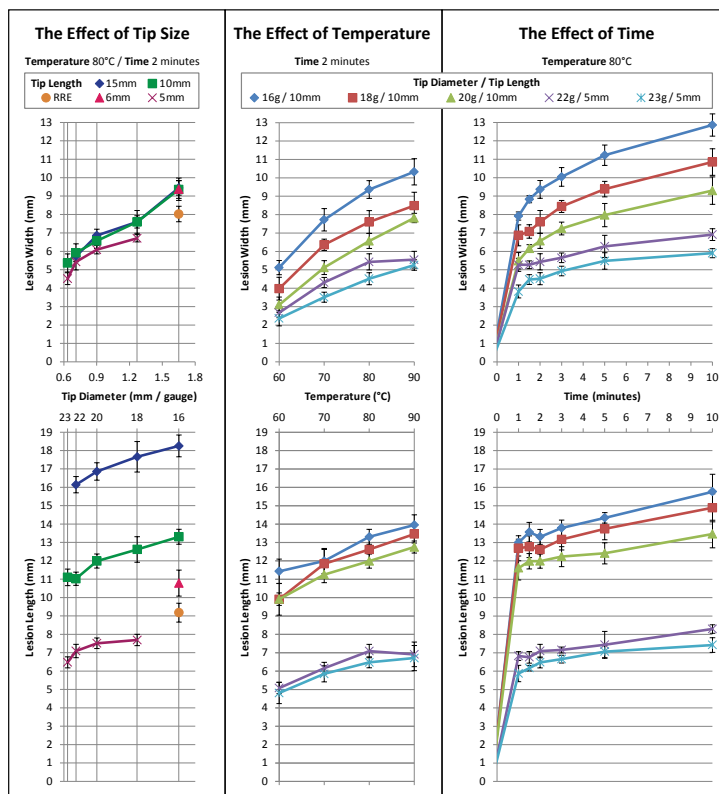




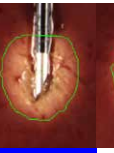


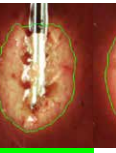

Figure 2 Average and standard deviation of standard monopolar lesion size ex vivo. Size may differ in actual clinical use.<sup>2</sup>

## Bipolar RF in 3D


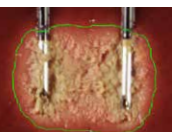
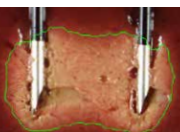







Figure 4 Bio-heat Finite Element Modeling.<sup>5</sup>

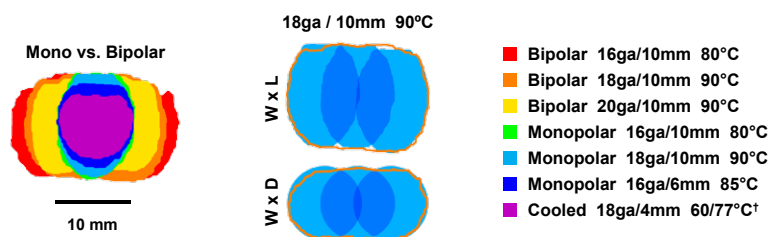
### Standard RF Using 16ga Cannulae at 80-90°C for 3 Minutes Produces Lesions as Large as SIJ Cooled RF

Cooled†	16ga / 6mm			18ga / 10mm	16ga / 10mm	
60 / 77°C	80°C	85°C	90°C	90°C	80°C	90°C
						
W = 9.9 L = 8.9 V = 0.48	9.2 10.5 0.48	10.2 11.3 0.62	10.4 11.4 0.64	9.9 13.4 0.72	10.0 13.8 0.74	11.1 mm 14.5 mm 0.93 cm <sup>3</sup>

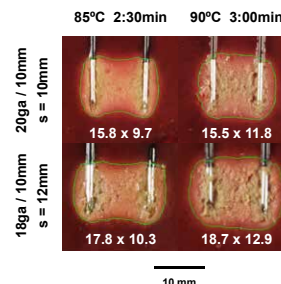
### Bipolar RF Produces Larger Lesions with 20ga Cannulae

	20ga / 10mm	18ga / 10mm	16ga / 10mm	
	90°C s=12mm	90°C s=12mm	80°C s=15mm	90°C s=15mm
W x L				
W x D				
W = 18.1		18.7	22.5	21.4** mm
L = 10.8		12.9	10.7	14.4* mm
D = 9.2**		9.4**	6.3**	9.8* mm
V = 1.28		1.46	1.49	2.03* cm <sup>3</sup>

### One Bipolar Lesion Has Shape Similar to Three Standard Lesions for the Same Cannulae and Settings

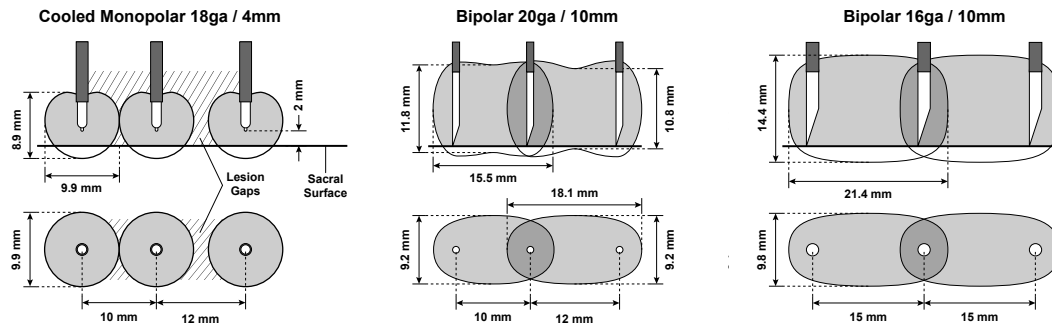


**Figure 5** Average lesion width *W*, midline length *L*, midline depth *D*, and estimated volume *V*. Total time 3:15 minutes unless noted. Standard cannulae: 15 sec ramp plus 3 min at set temperature. Cooled electrode (18ga/4mm tip, 17ga introducer) uses recommended SIJ settings: 45 sec pre-treatment cooling plus 2:30 min heating including 80°C/min ramp.<sup>3,4</sup> From left to right, the average maximal bipolar lesion lengths/depths are 12.9/9.6\*\*, 13.8/9.7\*\*, 13.5/9.4\*\*, and 15.0\*/11.0\* mm. \*Value from one sample. \*\*Value from two samples. †Tissue temperature measured at 77°C when the internally-cooled electrode measures 60°C.



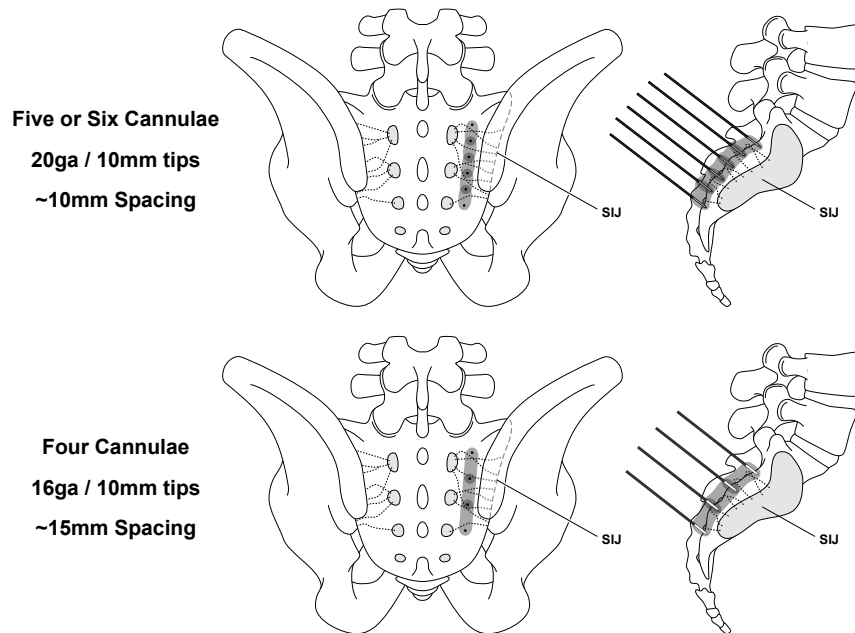
**Bipolar  
is Robust  
to Lower  
Temperature  
and Time**

### Sequential Bipolar RF Can Produce a Consistent Strip Lesion. Sequential Standard or Cooled Monopolar RF May Produce Lesion Gaps.



**Figure 6** Comparison of sequential monopolar and bipolar heat lesioning with tips perpendicular to an idealized bony surface, such as the dorsal sacrum. Based on Figure 5 settings and results.

### Palisade Bipolar RF for Sacroiliac Joint (SIJ) Denervation



**Figure 7** Palisade bipolar lesioning of the sacral lateral branch nerves for sacroiliac joint (SIJ) pain. (Top) As demonstrated clinically in Cosman and Gonzalez (2011), five or six 20ga/10mm tip cannulae spaced by 10-12mm are lowered to the dorsal sacral surface between the lateral aspect of the sacral foramina and the ipsilateral SIJ. A sequence of four or five bipolar lesions at 90°C/3min are generated between adjacent cannulae to lesion the space through which target nerves travel at irregular locations.<sup>1</sup> (Bottom) Four 16ga/10mm tip cannulae spaced by approximately 15mm theoretically produce a similar lesion zone.

1. Cosman ER Jr, Gonzalez CD. Bipolar Radiofrequency Lesion Geometry: Implications for Palisade Treatment of Sacroiliac Joint Pain. *Pain Practice* 2011;11:3-22.
2. Cosman ER Jr, Dolensky JR, Hoffman RA. Factors That Affect Radiofrequency Heat Lesion Size. Poster session presented at: Annual Meeting of the American Academy of Pain Medicine; 2013 April 11-14; Fort Lauderdale, FL, USA.
3. Cohen SP, Hurley RW, Buckenmaier III CC, Kurihara C, Morlando B, Dragovich A. Randomized placebo-controlled study evaluating lateral branch radiofrequency denervation for sacroiliac joint pain. *Anesthesiology*. 2008; 109:279-288.
4. SInergy System User Guide PM1013 rev 09/08. Montreal, Canada: Baylis Medical Company, Inc.; 2008.
5. Cosman ER Jr, Cosman ER Sr. Electric and thermal field effects in tissue around radiofrequency electrodes. *Pain Medicine* 2005; 6(6): 405-424.